Congress of the United States
OFFICE OF TECHNOLOGY ASSESSMENT
WASHINGTON, D.C. 20510

JOHN H. GIBBONS
DIRECTOR

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September 1, 1981

Dr. Harry Rowen
Chairman
National Intelligence Committee
Central Intelligence Agency
Room 7E-48
Washington, D.C. 20505

Dear Dr. Rowen:

The Senate Committee on Foreign Relations has asked OTA to examine technical options that may help the United States during a disruption of imported oil. They asked us to concentrate on the supply and demand alternatives that could supplement both a strategic petroleum reserve and any allocation scheme that might be in existance. In order to effectively carry out this assignment it is important that we identify the critical issues and how we should analyze them. To help with this task we are organizing a one day meeting on September 23, 1981, of people who are knowledgeable about the subject or particular aspects. We would like you to participate in that meeting. Your considerable work on the effects of supply disruptions will provide a strategic view, and should help us obtain the important issues from all the participants.

As a starting point, we are enclosing the proposal we prepared when we submitted this study to our Technology Assessment Board. We want to build on this proposal, modifying our directions where necessary. We intend to make short presentations, at the meeting, on our study's objectives and how they compare with other studies on the subject of oil disruption. Beyond that, however, the meeting will be fairly unstructured.

The meeting will be in the OTA Conference Room at 600 Pennsylvania Avenue, S.E., starting at 9:00 A.M. We hope that you will be able to attend and look forward to hearing from you.

Very truly yours,

Richard E. Rowberg

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Oil Disruption Study

I. Introduction and Background

For the next decade or two, the United States will continue to import a substantial portion of its petroleum needs from potentially unstable sources, in a world where increasing competition for a steady or declining volume of world oil will be the norm. Although imports have dropped significantly since 1978, they still supply 40% of the U.S. petroleum needs and two-thirds of the 40% comes from OPEC nations. (Total OPEC production in 1979 was 31.4 million barrels per day.) Increased efficiency of energy use and accelerated domestic production of energy from both conventional and new sources now characterize the American economy, but these alternatives to imported oil will not be able to offset imports completely for many years. Agreements to which the U.S. is committed as a member of the International Energy Agency require the major importing industrial nations to share available oil during a disruption based on a pre-determined formula. Therefore, the U.S. is committed to absorb a fraction of any major interruption of oil exports regardless of the nature of the disruption.

Twice since 1973 the U.S. has been subjected to a significant contraction of imported oil supplies which allowed a sharp increase in oil prices and caused increased inflation and a slowdown in economic growth. While these contractions did not reach the level of a major disruption, the economic difficulties they caused give us a glimpse of what would happen if a large fraction of the world oil trade were suddenly withdrawn for a prolonged period. In a 1980 study by the Department of Energy estimates of reduction in the U.S. gross national product were made for various levels of disruption of world oil trade. A loss of 3 million barrels per day for one year would

result in a GNP reduction of $85 billion (3.6% of GNP), a loss of 10 MMBD for a year would result in a GNP loss of $325 billion (13.7% of GNP), and a one year, 20 MMBD disruption would yield a GNP loss of $685 billion (28.9% of GNP). The same DOE study also made estimates of the probabilities that such disruptions would occur. The estimates obviously depend upon one's view of Middle East and world stability.* The following chart shows these probabilities as a function of a range of these views.

Hypothetical Probabilities of World Oil Supply Disruptions

(percentage probability for occurrence at least once in decade)
Size of One-Year Disruption

World Views*	3 mbd (one country)	10 mbd (Saudi-Arabia)	20 mbd (Persian Gulf)
1	50%	10%	5%
2	75	30	5
3	95	50	20

In addition to the economic problems that a supply shortfall would cause, there would be massive logistical and political problems concerning distribution of remaining supplies and a large increase in international tensions leading to possible military actions.

While a number of studies have been conducted over the past few years about oil disruption, most have centered upon the international implications,

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* The world-views used in the DOE analysis were constructed on the basis of attitudes reflecting three dimensions: 1) a pessimism-optimism range on disruption itself; 2) a range of views on the likelihood that OPEC countries would pursue a planned production course or adapt to a price-sensitive production level during disruption; and 3) a corresponding range on the likelihood of cooperation between oil-importing nations, moving from total conformity to agreements and unified action to unilateral action of each nation. These views were also used by DOE to analyze the effectiveness of various U.S. responses to a disruption. Reducing U.S. Oil Vulnerability Energy Policy for the 1980's, U.S. Department of Energy, November, 1980.

management strategies, strategic petroleum reserves (SPR), and macro-economic analysis. For example, GAO and the Congressional Budget Office are reviewing the Strategic Petroleum Reserve program, allocation possibilities, and SPR financing schemes. The National Petroleum Council has recently completed an analysis of various methods to fill the SPR, and has suggested the levels of oil shortfall which the private market and private reserves could accommodate. A particular area of work which OTA is uniquely qualified to undertake has not been examined as carefully, i.e., what are the technical options available to respond to a disruption beyond SPR? While SPR is generally regarded as the most effective means to combat a limited shortfall over the next decade, at least, there is a growing interest in other technologies that could supplement SPR. In particular, what are these technologies capable of contributing within a given period of time; what are the technical limitations of various energy resources in replacing petroleum during an emergency? This question was raised in a letter from Senator Charles Percy to the Technology Assessment Board, both in his previous Senatorial capacity as Ranking Minority Member of the Senate Government Affairs Committee of the 96th Congress, and currently as Chairman of the Foreign Relations Committee. Interest has also been expressed by the Senate Committee on Energy and National Resources and the House Committee on Energy and Commerce. This study proposal is in response to that request.

II. Proposal

The OTA study will examine a series of technical supply and demand options to help the nation meet a range of possible oil supply disruptions. Interruptions of up to a few years length will be considered. The study will not consider methods of implementing the SPR but will concentrate on the

physical capabilities of various energy technologies to alleviate petroleum product shortages resulting from a disruption. Thus, several levels of disruption will be analyzed, but emphasis will be placed upon disruptions sufficient to require accelerated use of various technologies in addition to management and market efforts. The study will also examine the technical and economic considerations in stockpiling these technologies or putting them in place for use in the event of an emergency. The technologies to be examined will include: enhanced oil recovery; retrofitting residential, commercial and industrial boilers and furnaces to adapt to gas fuels from liquids or electricity; construction of additional high voltage transmission equipment and resolution of technical problems now limiting the wheeling of electricity; coal gasification and liquifaction; nuclear electrical generation; biomass combustion; retrofitting of existing building envelopes and heating, ventilating and air-conditioning systems; wind power; hydro power; direct solar; solar electrical generation; technical aspects of refinery switching capacity; and technical methods to increase vehicle efficiency and otherwise reduce fuel consumption in transportation uses.

The analysis will first be done on a national, sector-by-sector basis. Key questions to be addressed include:

1. What is the current availability of these technologies? Is there any overcapacity and, if so, how long is it likely to remain?

2. What are the technical constraints of rapidly increasing the capacity of these technologies? How much increase could be expected in a few years?

3. What technologies would be needed in the demand sectors in order that these supply technologies could replace petroleum products?

4. What are the technical limitations on energy transportation and delivery systems that could constrain each of these supply options in substituting for petroleum?

5. Can any of these alternate fuels be expected to substitute for petroleum feedstocks over the period of a disruption?

6. What storage capacity exists for these technologies? Can material and equipment used to produce these technologies (e.g., insulation, alcohol fuels) be stockpiled? Is there currently overcapacity in any of these production areas? What is the cost of the overcapacity?

7. How much and what type of petroleum products could be replaced by these technologies under emergency conditions?

8. What are the technical constraints on converting refinery capacity or utilizing existing refinery capacity to produce the required slate of petroleum products during an emergency, after the technologies we are considering are put in place? For example, if natural gas, coal or wood most effectively replaces residual fuel oil and an excess of residual fuel oil appears, can the excess be effectively converted to more needed products such as distillate fuel oil or gasoline?

9. What are the principal economic and environmental considerations of rapid buildup and use of these technologies? What are the key long term effects of a buildup?

10. Are there international concerns that would alter technical limits of these technologies to help in an emergency?

III. Method

The above questions are the focus of this study. We intend to address them in the following manner:

1. During the remainder of FY 1981, using OTA staff, we will collect the data needed to examine the technical capabilities and constraints described in the questions. These will be used to develop a concise summary of each of the questions which identifies the most important uncertainties about the technologies and their physical limitations in replacing oil. These summaries will be the basis of a two- to three-day workshop, to be held in FY 1981, composed of people knowledgeable about the technologies and the technical requirements of meeting an oil emergency. The workshop's purpose will be to narrow the limits of the uncertainties and give us a reasonable estimate of the potential for supplementing a SPRO in meeting a given disruption.

2. The summaries and workshop will provide two things. First, there will be a Technical Memorandum describing the potential for these technologies to alleviate a disruption. We expect this to be available by January 1981. Second, we will choose the most

promising technologies for further analysis in FY 1982. This will include a more detailed look at the uncertainties as well as an examination of the important economic, financial and environmental aspects. During this phase of the study we will also carefully analyze the technical questions about transmission, distribution and use of these technologies in place of oil. For example, what burner substitutions are necessary to use natural gas, wood, coal or alcohol fuels instead of fuel oil? We will do this using limited outside contracts to gather data and other basic information not already obtained, OTA staff analyses, and workshops. An advisory panel will be assembled. A final report on tehnologies to meet an oil supply disruption will be delivered to TAB in fall 1982. This should provide the basis for any Congressional action to supplement the Strategic Petroleum Reserve and the Emergency Petroleum Allocation Act with other ways to combat an oil cutoff.

Although the study will concentrate on the national picture, we will also attempt to discuss regional considerations. For example, distillate fuel oil is particularly important in the agricultural regions during harvest and planting seasons. Therefore it is important to understand how this would add to the technical requirements for supply and delivery of alternate technologies if a major disruption occurred then, and how much one could depend on these alternatives. Our principal objective here would be to catalogue these regional considerations so they are made explicit during any Congressional debate on measures to meet a disruption. Questions to be addressed in the regional analysis include: What are the end-use demands in the area? What are the current fuel sources? What resources are available in and suitable to the region that might be put into service? The regional aspect of the study would give reality to the abstraction and macro-economic concepts currently in many other studies, and would provide Congress with a basis for examining both the diverse set of techical responses and the places or circumstances where certain technologies can be most effectively applied.